REMARKS

This amendment corrects the status identifier for claim 11 as requested in the outstanding Notice of Non-Compliant Amendment dated March 30, 2009. Claims 11-18 and 20 are rejected. Claim 19 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form. Claim 11 is herein amended. No new matter is added. Claims 11-20 are now pending. The above amendments and the following remarks are considered by Applicants to overcome each rejection raised by the Examiner and to place the application in condition for allowance.

Rejection of claims 11, 13, and 14 pursuant to 35 U.S.C. § 112, first paragraph

The Examiner rejected claims 11, 13, and 14 pursuant to 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse the rejection, as the subject matter of these claims is well described paragraph [0009] and, more in detail, in paragraphs [0018] to [0021] in of the original specification.

Regarding claim 11, the Examiner contends that the terms "first selected frequencies" and "second selected frequencies" are not explained. Although these terms are not explicitly stated, a person of ordinary skill in the art would have understood their meaning. As the specification indicates, first frequencies are determined by splitting the entire frequency range of luminance and the chrominance channel signals into three underfrequency ranges (HF, MF, TF) generated by two bandpass filters and subtraction operations (as shown in Fig. 2), and then performing a comparison of energy levels between the luminance and chrominance channels on the basis of suitably chosen frequency ranges (namely, TF and/or MF) or relative values of those, which are representing the "first frequencies" for moiré detection. For the second frequencies, the same frequency splitting as explained above is used and a signal attenuation factor is merely applied to the chrominance channels (at least one) in the middle frequency range (MF) only. This frequency range (MF) represents the "second frequencies" for moiré suppression. In short, the first frequencies are used for color moiré detection and to the second frequencies color moiré correction is applied. A person of ordinary skill in the art, having read the specification (particularly paragraphs [0018] to [0021]) would have known that Applicants were in possession of an invention applying such "first selected frequencies" and "second selected frequencies."

As to claim 13, the Examiner contends that it is not explained how the splitting is performed. This mechanism, however, is explained in Fig. 2 and the accompanying portions of the specification, thus establishing that Applicants were in possession of this aspect of the invention.

As to claim 14, the Examiner contends that "the significance of using the middle-frequency underfrequency for the comparison is not expressed." Such an approach, however, is known to those of skill in the art, and is implicitly included in paragraphs [0003] and [0004] (Description of the Related Art), which provides that moiré patterns are substantially caused by sampling point beats at low frequencies due to the pixel raster and result in color moiré interference (middle frequency range). In other words, middle frequencies show most likely and most of all color moiré patterns. So the middle frequencies are preferential (overriding) for moiré pattern occurrences. Thus, a person of ordinary skill in the art would have known that Applicants was in possession of an invention using the middle-frequency underfrequency for the comparison. For these reasons, Applicants respectfully request removal of the written description rejections.

Rejection of claims 11 and 20 pursuant to 35 U.S.C. § 103

The Examiner rejected claims 11 and 20 pursuant to 35 U.S.C. § 103 as being unpatentable over Oktumi (US 20060038891) in view of Fuchsberger (U.S. Pat. No. 4,825,297). Applicants respectfully traverse the rejection.

Similar to the invention, Oktumi concerns the reduction of color moiré in digital images and makes use of a conversion of the color space into luminance and chrominance channels. In general, however, the solution of Oktumi is based on a different principle than the claimed invention. Oktumi generates a high-resolution image by a series of low-resolution raw images derived from an image sensor that is read out repeatedly after subpixel displacements. This causes the need for motion estimates, which are not a subject of the claimed invention.

There are also several specific differences. First, Oktumi teaches, "Since the chrominance is the difference between luminance and the RGB signals (see Equation 25), a spectral energy function detects the correlation between these signals. Therefore, the spectral energy function takes into account of correlation characteristics between luminance and chrominance, and provides a ground for a signal process between color channels." (See par.

[0099]) The Oktumi approach is different from the claimed invention in at least the following significant respects:

a) The Oktumi approach uses a complex forward estimation model (see [0077] and model explanation section before). The starting point is a series of low-resolution raw images to be converted into one high-resolution image. The claimed invention has no such precondition.

b) In order to detect sudden changes in the chrominance signal, a linear operator Q being a differential approximation of the Laplacian operator is applied to every chrominance signal. If this processing results in local continuity of an estimated image, the chrominance signal is set to higher priority. Otherwise, the coefficients in color space transformation process are corrected ([0096]-[0098]). There is no equivalence to the invention concerning the moiré detection criterion.

c) As a further explanation to paragraph [0099], it is disclosed in paragraph [0100] of Oktumi that a color correlation constraint is appropriate and, therefore, a limited window size for applying the filter Q (Laplacian operation) is chosen. For proving small correlation of the color channels according to Oktumi, see paragraph [0127]: "... color space having a color component of small correlation...". This precondition is diametrically opposed to the moiré detection of the invention, which requires a significant color correlation because the correlation is used for the moiré detection by comparison of energy levels between the luminance and the chrominance channels. Additionally, the moiré detection according to the invention is carried out for every single image pixel, which is in contrast to the defined window size according to Oktumi.

As already mentioned above regarding paragraph [0127], the suppression of the color moiré according to Oktumi is based on the precondition of low correlation between the luminance and chrominance channels. In contrast to this, the invention acts on the assumption that a significant correlation exists between luminance and chrominance channels. This can be proven by the invention's measure that the detection of color moiré is only performed in the luminance channel in order to decide whether or not an attenuation has to be applied to an image pixel signal in the chrominance channels.

Second, the Examiner is incorrect in assuming that Oktumi discloses a detection of the color moiré on a pixel by pixel based energy level comparison of the chrominance to the luminance signal. In paragraphs [0087]-[0088] cited by the Examiner, there is no disclosure of an energy detection between luminance and chrominance channels image point by image point (i.e., pixel by pixel) according to the invention, but an application of an edge detection function

to every pixel by analyzing the pixel environment in order to determine an edge direction map. That is clearly to be seen in Figs. 4 and 5 cited by the Examiner. Although the edge detection function is applied to each single image pixel, this method is not at all equivalent to the invention's energy level comparison between pixel-assigned luminance and chrominance signals for each single pixel (without taking into account any environmental pixels).

Third, there is also a clear difference in using the luminance and chrominance channel signals. It is clearly not true that Oktumi discloses to process the luminance and chrominance channels by a plain signal energy level comparison for each single pixel. Oktumi only teaches the use of a spectral energy function that "takes into account ... the correlation characteristics between luminance and chrominance" and is then used for adapted processing of the chrominance channels based on the edge preserving operator adaption of the spectral energy function. This is much more complicated and complex (because of functional behavior of edge detection applied) and also different because of a constraint correlation characteristics as explained to paragraph [0099] above.

Fourth, as to paragraphs [0130]-[0135] cited by the Examiner to prove the anticipation of first frequencies used for the color moiré detection, there is a clear misinterpretation of the frequency filtering according to Oktumi in contrast to the invention. Oktumi teaches to use "an edge preserving anisotropic smoothness condition (is) taken into the regularization term to prevent ... excessive smoothing" and to use (in equation 38) "a high-pass operator ...that evaluates smoothness in direction D in each pixel: horizontal, vertical, and diagonal (two ways) directions ..." [0130] This teaching provides a processing principle totally different from the invention and a high-pass operator having a diagonal matrix A_d providing each element with "a weight with respect to a high-pass operation in the edge direction. The weight is determined by detecting the edge direction ..."

Fifth, the Examiner is also incorrect in contending that paragraph [0081] of Oktumi would teach something equivalent to the correction of energy values according to the invention. Quite the contrary, in paragraph [0081], Oktumi discloses the energy function for the image reconstruction, which is unrelated to the claimed color moiré correction as well as the parameter μ for the adjustment between the spatial. Further, the Examiner misuses spectral energy terms of the energy function in the context of false color suppression of paragraph [0135].

As to paragraph [0117] of Oktumi, the disclosure does not match to the application of color moiré correction in at least one chrominance channel according to the invention. Oktumi

only discloses the overall process of high-resolution color image reconstruction from raw color mosaic image sequences. Although *motion estimation* is included in that process as being applied to at least one *color channel* (RGB), there is no disclosure of applying *energy value attenuation* to each pixel signal of at least one *chrominance channel*.

It is also incorrect that Oktumi could have implicitly disclosed first selected frequencies for color moiré detection. Oktumi has a totally different principle of moiré detection using an edge detection algorithm and adapting the color space transformation therewith. Thus, a teaching of first and second frequencies according to the invention is not derivable from Oktumi.

As to the back transformation of the image pixel data from the luminance and chrominance channel into the RGB color space, the Examiner cites Fuchsberger. Fuchsberger, however, discloses an apparatus for contrast enhancement that does not concern color moiré suppression. The comparison of contrast enhancement and color moiré correction methods are entirely unrelated, and therefore a person of ordinary skill in the art would not have known to combine the teachings of Fuchsberger with the teachings of Oktumi.

For the foregoing reasons, Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art to arrive at the invention of independent claims 11 or 20. Accordingly, Applicants respectfully request withdrawal of the obviousness rejections.

Rejection of claim 12 pursuant to 35 U.S.C. § 103

The Examiner rejected claim 12 pursuant to 35 U.S.C. § 103 as being unpatentable over Oktumi in view of Fuchsberger, Saito (U.S. Pat. No. 7,227,552), and Hunter (U.S. Pat. No. 7,006,686). Applicants respectfully traverse the rejection.

Claims 12 depends from independent claim 11. As claim 11 is allowable, so must be claim 12. Further, Oktumi, Fuchsberger, and Saito each fail to disclose using the green channel in an unchanged manner after color space transformation. Hunter also fails to disclose this limitation.

Hunter discloses a kind of image reconstruction similar to Oktumi. Hunter generates a high spatial frequency luminance image across all pixel locations wherein each pixel has a luminance value, and generates a low spatial frequency luminance image from each color value of the image mosaic and then, after an pixel adjustment, combines the high frequency luminance pixels with the low frequency luminance pixels over all pixel locations.

As earlier prior art to the Hunter approach, there is described that the green mosaic pixel has a higher sample rate compared to the red and blue sample channels. However, this is due to the double occurrence of green mask filters on the sensor chip and has nothing to do with an unchanged transformation into a luminance channel of another color space, which is not described for the Hunter approach.

As to Hunter's background art description (col. 1, lines 65-68) cited by the Examiner, the luminance signals are always generated by adding the green channels to the red and blue channels to achieve the luminance mosaic images. There is no disclosure of a color space transformation leaving the green channel unchanged for defining the luminance channel of the new color space.

For these reasons, Applicants respectfully submit that the cited references do not render dependent claim 12 obvious. Accordingly, Applicants respectfully request withdrawal of the obviousness rejection.

Rejection of claims 13-18 pursuant to 35 U.S.C. § 103

The Examiner rejected claims 13-18 pursuant to 35 U.S.C. § 103 as being unpatentable over Oktumi in view of Fuchsberger, Saito, Hunter, and Enomoto (US 20020196472). Applicants respectfully traverse the rejection. Claims 13-18 depend from independent claim 11. As claim 11 is allowable, so must be claims 13-18. Thus, Applicants respectfully request withdrawal of the obviousness rejection.

An early action on the merits of these claims is respectfully requested.

Respectfully submitted,

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